Introduction

Environment is defined as the sum total of all the conditions and circumstances and the living and non-living things around an organism, which affects its life. Human and environment are closely interwoven with each other, to maintain a balance or equilibrium in nature. With the increase in population and development, there is a tremendous increase in the pollution levels which leads to environmental degradation. The primary causes of environmental degradation along with increased population are exploitation of natural resources, industrialization, urbanization etc. Pollution of all sort like air, water, land along with solid waste and its disposal eventually degrade environment as well as human health.

Waste (also known as rubbish, trash, refuse, garbage, junk, litter, and ort) is unwanted or useless materials. Waste includes all items that people no longer have any use for, which they either intend to get rid of or have already discarded. Additionally, wastes are such items which people required to discard.

Waste gets generated from each and every activity of human, which eventually degrades the quality of human health and accelerates the degradation of the environment at an alarming rate. Wastes according to Kimenju and Groote (2008) are discarded substantial products of human activities that are regarded as unwanted or useless. Wastes are substances or objects which are disposed or are intended to be disposed or are required to be disposed of by the provisions of national laws.

In the beginning of 18^{th} century and even before, biodegradables were the major components of waste, which mainly consists of residues from fires, wood, bones, dead bodies and vegetable wastes. Disposal of such waste do not pose any sort of harm to the environment rather adds to the increase in fertility of the soil. With decrease in availability of land for the disposal of waste and increase in population, industrialization and urbanization disposal of waste has become a major problem. As people are moving toward cities and towns to accomplish their basic needs, they gather in relatively smaller regions for their livelihoods, thus leading to generation of huge amount of waste in smaller area (Shafiul and Mansoor, 2004).

Modernization and progress has had its share of disadvantages and one of the main aspects of concern is the disposal of waste. In all metropolitan cities and most large cities in India, about 50 to 60% of the municipal waste collected is dumped in open dumpsites (Rathi, 2007). The rest keeps lying around in municipal bins and roadsides for several weeks to months, becoming a breeding ground for rodents, flies, mosquitoes, and disease causing germs including bacteria, molds & viruses. Furthermore, this untreated waste pollutes air, water, soil, food and adversely affect the aesthetics and sensibilities of citizens.

Apart from all the environmental problems caused by waste, it also build number of problems in economically developing nations, as they are facing challenges in treating the waste generated (Arlosoroff and Bartone, 1987). India is a developing country and facing waste disposal crisis, but solutions are not impending. As it is being known waste can be used in industrial process and also for generation of energy appropriate management of waste is being found. Today, management of waste is a challenge accompanied by numerous factors adding constraints and complexity to the process (The Expert Committee, Ministry of Urban Development, Government of India, 2000). Therefore it is generally understood that proper waste management helps to protect health, environment and also preserves natural resources.

Increasing amount of waste is one of the major concern which causes environmental degradation. Waste can be solid or liquid. Solid waste can either be organic or inorganic such as product packaging, grass clipping, furniture, clothing, kitchen refuse, paper.etc produced in society.

Source	**Typical facilities, activities, or locations where wastes are generated**	**Types of solid wastes**
Residential	Single-family and multifamily cardboard, plastics, high-density apartments; etc.	Food wastes, paper, cardboard, plastics, dwellings; low-, medium-,and textiles, leather, yard wastes, wood, high-density apartments; etc. glass, tin cans, aluminum, other metal, ashes, street leaves, special wastes (including bulky items, consumer electronics, white

		goods, yard wastes collected separately, batteries, oil, and tires), and household hazardous wastes
Commercial	Stores, restaurants, markets, office buildings, hotels, motels print shops, service stations, auto repair shops, etc.	Paper, cardboard, plastics, wood, food wastes, glass, metal wastes ashes, special wastes hazardous wastes, etc.
Institutional	Schools, hospitals, prisons, governmental centers, etc.	Same as for commercial
Industrial (non-process wastes)	Construction, fabrication, light and heavy manufacturing, refineries, chemical plants power plants, demolition, etc	Paper, cardboard, plastics, wood, food wastes, glass, metal wastes, ashes special wastes (see preceding), hazardous wastes, etc.
Municipal solid waste	All of the preceding	All of the preceding
Construction and demolition	New construction sites, road repair, renovation sites, razing of buildings, broken pavement, etc	Wood, steel, concrete, dirt, etc
Municipal services (excluding Street treatment facilities)	Street cleaning, landscaping catch-basin cleaning, parks and beaches, other recreational areas, etc.	Special wastes, rubbish, street sweepings landscape and tree trimmings, catch basin debris; general wastes from parks, beaches, and recreational areas
Treatment facilities	Water, wastewater, industrial, treatment processes, etc.	Treatment plant wastes, principally composed of residual sludges and other residual materials
Industrial	Construction, fabrication, light and heavy manufacturing, materials, refineries, chemical plants, power plants, demolition, etc.	Industrial process wastes, scrap materials, etc.; nonindustrial waste including food wastes, rubbish, ashes, demolition and construction wastes, special wastes, and hazardous waste
Agricultural	Field and row crops, orchards, vineyards, dairies, feedlots, farms, etc	Spoiled food wastes, agricultural, wastes, rubbish, and hazardous wastes

Table 1: Various sources of solid waste along with their generation source

Source: Sources of Solid Waste (Tchobanogious and Kreith, 2002)

Management of solid waste

Management of solid waste resulting from rapid urbanization has generated a lot of concern in most developing countries. Especially during the last decade the volume and complexity of solid waste generated particularly in large cities, have been increasing at an unprecedented rate. This increase has been attributed to two main drivers: intensification of urbanization and rising living standards (Rathi, 2007).

The Solid Waste Management (SWM) system comprises of four activities: waste generation, collection, transportation and disposal SWM, therefore requires adequate infrastructure provision and maintenance for all the above mentioned activities. When not managed adequately, solid waste generates several public health and environmental hazards. The increasing volume and complexity of solid waste pose the greatest challenges to large cities in developing countries, where organization and planning of solid waste collection and disposal services tend to be elementary. Solid waste management is an important concern for environmental hygiene and it needs to be integrated with total environmental planning (WHO Expert Committee, 1971). A number of processes are involved in effective management of waste for a municipality. Management of solid waste reduces or eliminates adverse impacts on the environment and humans, and supports economic development and improved quality of life.

Fig 1: Waste Management Hierarchy

(Source: "The Sustainability Hierarchy" Envirobiz Special Report, 2010)

Temple waste

Flowers come as waste from various sources like hotels, marriages, gardens, temples, *dargah* and various other cultural and religious ceremonies. In India, religion is a path of life. It is an intrinsic element of the entire Indian tradition. People worship Gods and are accustomed to go to the temples offering flowers, fruits, coconut and sweets, etc. The bulk of the flowers, leaves of different plants, coconut shells, milk and curd are piled up and then disposed of exclusively in water bodies (Singh and Singh, 2007).

Fig 2: Temple waste

Everyday these flowers are offered by devotees in temples and are left unused and therefore become waste. India is a country of festivals and many occasions are celebrated round the year which eventually leads to the generation of solid waste. This proportion of waste is generally neglected and requires due considerations. Because of our religious beliefs many of us avoid throwing flowers and other items that are used for prayers in the garbage, and instead put them in the plastic bags and throw them directly in the water bodies, apart from this; it is also thrown near sacred trees with no suitable mode of disposal. For instance, Banaras, one of the holiest cities of the country, has no policy for the disposal of the tonnes of waste that comes from its many temples. Each day waste material weighing 3.5-4 tonnes is left behind in the city of temples (Mishra, 2013).

Fig 3: Floral waste from temples.

Amount of flower wastes vary from city to city. Some cities in India are specially known for temples and pilgrimages. In such cases the flower waste content in the waste is increased, and over tenfold during special occasions like festivals etc, Some of the major flowers offered in temples are: Jasmine, Marigold, Chrysanthemum, Hibiscus, Rose etc, these flowers are either discarded as waste or given for decoration and to devotees, whichever way it be they are finally thrown away and find their way into environment unless handled otherwise (Swapnavahini *et al.,* 2010).

Degradation of floral waste is a very slow process as compared to kitchen waste degradation (Jadhav *et al.*, 2013). Therefore there is a need for proper and ecofriendly process for floral waste treatment. Management and utilization of flower waste was carried out in some studies. One such example is the Kashi Vishwanath temple which draws maximum devotees all round the year, especially in the month of *Shravan*. It has its own system for disposal of hundreds of kilograms of waste resulting from offerings by devotees; the floral waste generated in the temple is converted into manure (Mishra, 2013).

To avoid ill effects caused by disposal of these offerings they can be used to make some valuables. Like burning of incense stick produce smoke (fumes) which contain Particulate Matter (PM), gas products and many organic compounds also, therefore flower petals obtained from temples can be use to make herbal incense sticks. Flowers like *genda* are used to make incense sticks, while roses are converted to rose water. Besides incense and rosewater, the flowers can

also be incorporated into herbal products such as herbal colours, natural dyes etc. (The Hindu, Jan., 2013).

Another case where floral waste management has yielded good pay offs is that of Ajmer *Sharif Dargah* of *Khwaja Moinuddin Chisht*i where nearly 15 to18 Quintals of flowers, offered each day were used to be dumped in a well. Now, the flowers are not only recycled, but also generate employment for local women. With technical assistance from Central Institute of Medicinal and Aromatic Plant (CIMAP)**,** Lucknow, the *Dargah* Committee has established a rose water distillation plant at the outskirts of Ajmer (Indian Express, May, 2010).

Hand made paper

Paper was made by hand for thousands of years until, during the Industrial Revolution of the 18th century, machinery was invented that could mass-produce paper. Over 5,000 years ago, the Egyptians made a type of paper from an aquatic plant called papyrus. The stems were split, woven, and then dampened and beaten into flat sheets, which were polished smooth with stones. The Chinese patented the true paper as we know it today. The trees used for paper depend upon the kind of paper that is going to be made. In general, the species include the softwood jack pine, red pine, and white pine tree species and the hardwood aspen tree species.

The paper industry is a forest based industry. Depleting forest cover is a major cause of concern. As hand made paper is an eco-friendly and environmentally clean product it is a sustainable product for environment. Hand-made paper is defined by (Dhaked *et al.,* 2003), as "A sheet of paper or board produced by hand". In 1995 the production of handmade paper and board was 13,000 tonnes valued Rs 250 million which is 0.4% of the total paper production in India.

Handmade papermaking units can make many of the specialty papers, whose demands are limited and therefore uneconomical to produce on a conventional paper machine. These varieties include fancy and decorative base paper, personalized stationary paper, deckle edge papers, ultra thin backing paper, permanent paper for museums, archives, and libraries, durable paper for certificates, legal documents etc.

Due to increase in demand of paper and board in recent decades much attention has been laid over production of pulp from non-wood recourses. The majorly used non-wood resources are agricultural waste, bagasse, cereal straw, cotton stalk, rice straw, jute, textile waste etc. Usually the raw materials used in handmade papermaking are the waste products of the textile industry, different bast fibers available locally and recycled secondary fibers. Almost all bast fibers, leaf fibers and cotton and linter fibers are from annual plants and therefore have short renewable cycles. Pulping of these raw materials is based on the use of non-polluting chemicals such as lime, soda ash, caustic soda, oxalates, oxygen, and peroxides which leaves hardly any negative impact on environment. It is not necessary to use harmful chemicals like alkali sulphide and sulphite, chlorine and chlorine compounds for the delignification processes.

In India an estimate 1450 tonnes of flowers are being offered to deities per day and unfortunately, these are termed as waste once they are discarded and cause environment pollution (Ravishankar *et a.l,* 2014). Very slightest attention has been paid so far on this kind of waste. Extraction of pulp can be made out of these flower petals also which can be use in making paper. Increasing demand for paper and the invention of printer raised the need for low-cost raw material.

The handmade paper made from flower waste has the advantage of being 100% wood free, it is free from all chemicals and leaves no harmful by products during the manufacturing which makes it the eco-friendly form of paper around. Apart from being made of 100% recycled waste, the paper itself is recyclable. Hence, the concept of reduce; reuse and recycle can be very well implemented in handmade paper making. In this way, the problem of disposing the flower waste may be solved. By adopting such practices, a better environment can be created, thus reducing disposal problem also.

Objectives of the study

- Survey of selected popular temples of Jaipur city to gather information about the waste generated and the methods of disposal used.
- Quantification and estimation of the proportion of biodegradable and non-biodegradable waste generated in the selected temples
- Segregation of the floral waste generated in the temples in the city.
- Proximate analysis of the segregated floral waste.
- Development of a simple method of recycling the floral waste for making handmade paper.
- Optimization of pulping procedure for floral waste.
- Physicochemical analysis of the effluents generated during the process of paper making.
- Proposal of alternative eco-friendly methods for waste disposal in temples to promote "Green Temple Concept" so as to prevent the un-ecofriendly methods of waste disposal at temples.

Review of literature

Human beings are the most intelligent living organism on Earth; they can alter their environment according to their needs. Greedy nature of human is accountable for the deteriorating quality of its environment. All the fundamental resources of human development are obtained from its surroundings, thus its optimal utilization and sensible management is important for progress (Manimozhi *et al.,* 2006). Due to massive increase in population, exploitation of natural resources has also increased. Therefore it is necessary to utilize the available natural resources efficiently. The increasing trends of population have also increased the rate of generation of solid waste. In India, rate of generation of solid waste was 27.8% in 2001 and expected to reach 41% by 2021. Currently total solid waste generated in India is around 42 million tonnes annually. Waste generation varies from 200-600 kg/capita/day and collection efficiency ranges from 50-90%.

Solid waste can be of various types depending upon their sources of origin. Ramachandra, 2011 described types of waste depending upon their sources of origin as agricultural, industrial, commercial and institutional and municipal solid waste. The accumulation of waste has increased together with rapid rise in residential colonies, fast food outlets, vegetable markets, fruit shops and other customer outlets in respective areas. According to Vishwananthan (2005) the amount of solid refuse is constantly increasing and its treatment and disposal has become a major social and environmental issues as well as challenges. The disposal of these materials causes extensive unpleasant odor problems and contamination of ground water (Edwards and Bater, 1992). Thus strengthening our environment through proper handling of waste is an essential need of the hour (Manimozhi *et al.,* 2006). Ahmad *et al.,* 2011 reviewed that improper management of solid waste is not only a cause of environmental degradation but also poses risk to the human health. Various techniques like composting, inceneration, burning, landfilling *etc,* are generally used for the utilization and management of waste, Bundela *et al.,* (2010).

India is a country of spirituality. Worshiping is an intrinsic element of entire Indian tradition. While worshiping devotees offer different offerings to their deities, the major and common component of the offering is flower. Once they are offered eventually they find their way to dustbins. Mishra and Joshi (2002) proclaimed that Haridwar city generates 1873.7 kg organic

matter everyday. During important six festive occasion's 20,435 kg solid waste was generated in year 1997.

Ganga, the national river of India, originates from Himalayas and passes through many cities and gets polluted due to discharge of untreated municipal waste and industrial waste. Along with this Ganga also receive huge amount of floral waste and ashes of dead bodies on its bank. Kanpur to Trighat is the most polluted section of the river and needs special attention to get rejuvenate (Das, 2011).

Like other biodegradable wastes, flower waste was also used in some studies for varied purposes. Several studies were undertaken to study the management and utilization of this waste.

Vermicomposting

Pattnaik and Reddy, (2009) determined the major nutrient status of vermicompost of vegetable market waste and floral waste processed by three species of earthworms viz. *Eudrilus eugeniae, Eisenia foetida* and *Perionyx excavatus* and its simple compost and concluded that the nutrient status of the vermicomposts produced from both the wastes using all the earthworm species was more as compared to the compost.

Shouche *et al*; (2011) used various processes like composting followed by vermicomposting to manage floral waste. They used different proportion of mixtures of cattle dung and floral wastes to prepare vermicompost. Various parameters like temperature, pH and moisture content, which showed some periodic changes in the beginning and become stable at the end.

Vermicomposting of temple waste (Nirmalya) obtained from Ganesh temple, Sangli, Maharashtra was done by Gaurav and Pathade; (2011). They use effluent produced from biogas digester and mixed it with temple waste and cattle dung which was then allowed for the decomposition for retention period of 30 days at 30°C. The mixture obtained was used to fill the tubes of 2 kg capacity and parameters like moisture content, particle size pH and temperature were analyzed from it. They concluded that 25°C temperature, pH 8.0, 1-2 mm particle size and 80% moisture content were finest parameters for vermicomposting. Vermicompost obtained at the end was also rich in carbon (28%), nitrogen (1.58%) phosphorus (0.33%) and potassium (0.28%). The prepared vermicompost was also used to done pot culture study as a fertilizer with

five flowering plants. They showed good growth parameters in term of height, flowering time as well as number of flowering time as well as number of flowers produced as compared to the control sets, which were not treated with vermicompost. Hence, vermicomposting of flower waste is an excellent and eco-friendly method of flower waste management.

Jadhav *et al*; (2013) undertook a study to develop a microbial constrium for the effective degradation of flower waste generated from temples. They collected soil samples from the areas near and around the temples and bacterias were isolated from these samples. Flower waste collected was deride and mixed with agar medium and streaking was performed with selected soil samples for isolation. It was observed that microbial constrium enhance the digestion of the waste and the bio-manure constrium was found very well in quality and posed no harm to the environment.

In the study conducted by Singh *et al*; (2013), management of flower waste was done by using vermicomposting technology which was then compared with kitchen waste and farm yard waste vermicompost. The physic-chemical analysis of the flower waste vermicompost showed better result in comparison to both other waste composts. Along with it plant growth parameters were also studied for the above mentioned vermicompost which revealed that temple waste vermicompost should enhanced growth parameters of plants.

In Thoothukudi, numerous dry flower industries are situated, which process flowers and export them to many countries. The waste produced from these industries contain large amount of organic waste, which mainly consists of flower waste. Silvuai and Aneeshia; (2014) worked on the making of valuable compost of this waste. They used fungus like *Ganoderma incidum, Pleurotus sapidus* and *Pleurot flabellatus* and from all these *Pleurotus* species were found very effective in the decomposition of waste and produce cost effective compost.

Tiwari, (2014) carried out a research with the aim to utilization and manage floral waste obtained from ten popular temples of Jaipur city. To reduce the floral waste, vermicomposting technology was used by them. Marigold (floral waste) was collected, segregated and composted in earthen pots in different ratios. Various parameters like pH, temperature, moisture content, organic carbon, available phosphorus, *etc.* were evaluated of the obtained vermicompost. It was proved from the study that flowers can be very well used as substrate for vermicomposting.

Extraction of dyes and essential oils

Khan and Rehman, (2005) worked on the extraction and analysis of essential oil of *Rosa* species, they evaluated various parameters like oil yield, colour and other physical and chemical properties of two different species of rose that are *Rosa demascena* and *Rosa centifolia*. They concluded from their study that there was quantitative and qualitative difference in chemical composition, aroma constituents of essential oil of two species.

Vankar *et al.,* 2009 reviewed from his study that enormous amount of flower waste is produced in temples of India which can be utilized in making dyes for dyeing of cotton, wool and silk on industrial scale. They used (marigold) *Tagetus erecta* petals which mainly consists of carotenoids-lutein and flavonoid-patuletin, these colorants have been identified, isolated and used for dyeing textiles. Pretreatment with 1-2% of metal mordant and 5% of plant extract was found to be satisfactory and showed very good result to dye cotton, wool and silk.

A survey was conducted by Perumal *et al.,* 2012 in and around five temples of Chennai, Tamil Nadu to evaluate the amount of flowers offered there. Around 2350 kg of flowers were offered every day and the common flowers were rose, marigold, chrysanthemum and jasmine. Out of all flowers they collected rose petals and shade dried them to extract essential oils from them by using steam distillation process. The chemical components of rose oil were analyzed by GC-MS technique. 54 compounds were recorded out of which phenyl ethyle alcohol (23.19%) was recorded as major component followed by octadecane (10.49%), hexadecane (7.76%), phenyl ethyl decylester (5.77%) and tetra methyl trisilocen decanol (3.45%).

Teli *et al.,* 2013 undertaken a study with the aim to isolate natural dyes from the flowers of hibiscus and marigold and apply them on the cotton and cotton/silk blended fabric with the help of different natural mordents like alum, harad and ferrous sulphate. As the awareness among people for using natural dyes is being increased due to some toxic effects and allergic reactions associated with synthetic dyes. They concluded that the dyes extracted showed a very good potential to dye cotton and cotton/silk blended fabric.

Bio-gas generation

The biogas yield and nutrient reduction potential of *Ocimum sanctum* leaf waste obtained from temples was investigated by Swapnavahini *et al.,* 2010. For retention period of 30 days leaf waste was digested in a batch reactor at room temperature. Along with biogas production the process removed up to 73% and 42% of total solids and Biochemical Oxygen Demand (BOD) respectively.

A comparative study of solid waste generation at Mansa Devi and Chandi Devi Temples in the Shiwalik Foothills was conducted during the *Kumbh Mela* 2010 by Kaushik and Joshi, (2011). Total amount of solid waste generated for seven days of collection was found to be 7615.0 kilograms and 4992.7 kilograms at Mansa Devi and Chandi Devi temples, respectively. At Mansa Devi hillock the volume of solid waste comprised of about 64.7% biodegradable waste, 12.3% non biodegradable and 23.0% miscellaneous waste. On the other hand, the composition of waste at the Chandi Devi hillock was 62.1% biodegradable, 12.3% non biodegradable and 25.6% miscellaneous wastes. During normal non festive days, 62.7% biodegradable, 10.2% non biodegradable, 27.1% miscellaneous solid waste was found at Mansa Devi, at the same time 62.2% biodegradable, 13.4% non biodegradable and 24.4% miscellaneous was found at Chandi Devi hillock.

Shri Mahakaleshwar temple is from one of the 12 Jyotirlingas in India and produces around 3 tonnes of organic waste which mainly consist flowers. Agarwal, (2011) commence a study to produce energy from the temple waste. He used flower and kitchen waste to produce bio gas and vermicompost from them. At Mahakaleshwar, mahakumbh takes place every 12^{th} year, therefore he tried to develop a system there to generate energy from that waste.

Singh and Bajpai, (2012) worked on anaerobic digestion of flower waste for methane production. Gas chromatographer was the device used to determine the quality of gas produced and the experiment was conducted in cold atmospheric conditions in Luckhnow. They concluded from their work that the process eliminate the pollution effects caused due to flower disposal and also remove pollutants like BOD and TS along with biogas production

Kumar and Swapnavahini, (2012) commence a study with intend to produce biogas and analyze nutrient reduction potential of rose residue by anaerobic digestion in a batch reactor. They used a 2.5 L batch reactor which was filled with rose residue and allowed for digestion for 30 days retention period at room temperature. Various parameters like total solid (TS), volatile solid (VS), chlorides, biochemical oxygen demand (BOD), chemical oxygen demand (COD) and total kjedal nitrogen (TKN) were analyzed at5 days interval. The process remove up-to 73%, 45%, 82%, 42%, 58% of TS, VS, chloride, BOD, TKN respectively along with the production of biogas.

Apart from all the above mentioned uses floral waste can also be use in making of incense sticks, natural holi colours, herbal products and for ornamental purposes. The continuously growing paper manufacturing industry imposes a severe demand on green plants that forms the basic raw material for papermaking. Therefore, this waste can also be used for making of handmade paper and mottling.

Handmade paper making

The paper industry is a forest based industry and depleting forest cover is a major cause of concern. Kumar, (2001) reviewed in his paper about the possibilities of handmade paper making in India. The raw materials being used in handmade papermaking are the wastes products of the textile industries, different bast fibers which are locally available and recycled secondary fibers. He also researched on the treatment of final effluent by waste water hyacinth and natural polyelectrolyte. He studied possibilities of reusing treated waster so that “zero effluent mill” status can be achieved. Kumar concluded that handmade paper industries are small scaled and release minimum effluents, he also concluded that as the Indian economy is a rural economy, this production system will not only stop the wealth drain from rural to urban areas but also establish a strong industrial base for rural development.

Rousu and Anttila, (2002) through their study introduced a new type of chemical pulping process technology. The aim of the study was to focus on the physical and chemical properties of the raw material and their relationship with the environment friendly concept of cellulose and paper production. The chemistry and structure of the Chempolis process as well as certain properties relevant to pulp and paper qualities were described. The Chempolis process concept has been

designed to solve the global problems in pulp and paper industry by providing a novel solution. The process promotes sustainable development by recycling and re-using natural resources and saves the decreasing natural resources by exploiting waste material or other raw materials.

Various studies have been conducted out by Kummarappa National Handmade Paper Institute (KNHPI) Jaipur to prepare handmade paper from banana stem and leaves and also from the shredded currency waste obtained from Reserve Bank of India through enzymatic route. [Chauhan *et al*, (2009), Kumar and Kumar (2011), Kumar *et al,* (2013), Chauhan *et al*, (2014)]. It was concluded from the results that banana fibers have a vast potential for the manufacturing of handmade paper, as the content of fiber is high in its leaves and pseudo stem, moreover it is cost effective also. The shredded currency waste of RBI has also proved to be a cost effective alternative raw material for making handmade paper and adoption of the enzymatic route for recycling led to the production of a good quality paper in an ecofriendly manner.

Akbari, (2012) provides an overview of how fibers obtained from agricultural waste can be used for the production of handmade paper. He reviewed that non-wood fiber is one of the major sources available for the pulp and paper industry in developing countries due to their abundance and cost-effectiveness. In his study process he use fibers like bagasse, cereal straw, cotton stalks, canola and rice straw. He concluded that production of pulp from non-wood resources has many advantages like it has easy pulping capability, has excellent fibers for the special types of paper and they can be use effectively as a substitute for forest wood.

Modern handmade paper industries inspite of having utility also have a detrimental effect on the environment as they discharge large amount of effluent into nearby water bodies. Kulshreshta *et al.,* (2012) in their study have reviewed the treatment of effluent discharged from these large scale and small scale industries. They have made use of white rot fungi in nutrient present and nutrient absent conditions. The discharge was found to have high COD levels and possessed colours, which were reduced to significant level after treatment with white rot fungi.

Potentials of agricultural waste and grasses in pulp and papermaking were investigated by Ekhuemelo *et al,* 2013. The investigation has identified the feasibility of giant bluestem, bagasse,

maize stalk, peel from maize cob, Bahaman grass, gamba grass, pineapple leaf, banana stalk and banana leaf as non wood raw materials for paper making.

Tiwari , 2014 carried out research with the aim to utilize floral waste to extract pulp to make handmade paper from it. Flowers collected were treated chemically and enzymatically and properties like tear strength, tensile strength, burst strength and double fold were analyzed for both the types of papers. When chemically processed handmade paper was compared with the enzymatically processed paper of floral waste, the latter one was found to be slightly better in terms of physical strength properties as compared to that obtained from chemically processed floral waste.

Methodology

India is a country where worshiping is the way of living and people have immense faith in god. India has rich cultural heritage, which is being preserved in its well developed temples. There is hardly any city, town or any village in the country that does not have temples.

The study involves the following steps:

- **Selection of temples:**

  Jaipur is well known for its temples, it is also known as "*Chhoti Kashi*" due to its religious significance. There are temples in almost every part of the city. Since the study deals with the flower waste management and utilization in temples, therefore, flowers will be collected from the temples to make handmade paper. Temples will be selected on the basis of their popularity and regular availability of flowers.

- **Visit to the selected temples:**

  Regular visit will be made to the selected temples of the Jaipur city, to collect the primary data. Since each temple has its special days depending on the deities; days of visit will be selected accordingly.

- **Collection of data:**

  Some data will be collected with the help of questionnaire, which will be designed to interview the temple authorities regarding number of visitors, approximate quantity of waste generated daily/ daily festive seasons and the existing methods of disposal in the temples.

- **Collection of waste:**

  Temple waste will be collected from the selected temples once in a week or on special days as the amount of generation of waste varies from temple to temple depending upon the special days of the deities.

- **Characterization of waste:**

  The total waste will be characterized into bio-degradable and non-biodegradable waste, the degradable portion will further be characterized into flowers, cotton, food items, incense sticks *etc.*

- **Segregation of flowers:**

  Non-biodegradable part will be removed and flowers will be segregated from the biodegradable waste.

- **Proximate analysis of floral waste:**

  The floral waste will be then analyzed for the parameters such as ash, cellulose content, Lignin content, Cold and hot water solubility and alcohol benzene solubility. Analysis of these parameters will be done using standard TAPPI test methods (Table 2).

S. No.	Name of the parameter	Test Method Number
1.	% Ash content	T211 om-02
2.	Lignin, %	T222 om-02
3.	1 % NaOH Solubility	T212 om-02
4.	Solvent Extractives (Alcohol benzene solubility)	T 204 cm-97
5.	Cellulose Content (Alpha/Beta/gamma cellulose)	T 203cm-99
6.	Water Solubility	T 207 cm-99

Table 2: Standard Test Procedures of Proximate Analysis

***om-official method**

***cm-classical method**

- **Pulping:**

  On the basis of pulping for handsheet preparation, two experimental groups will be designed.

Group I: Chemical Pulping- Open hot digestion of the flower waste will be done with NaOH.

Group II: Enzymatic Pulping- The waste will be treated with different enzymes for preparation of pulp.

Optimization of the pulping process will be done in terms of enzyme and chemical doses and treatment and duration of the treatment/cooking time. Each group will be further sub-divided into three experimental sets on the basis of doses and treatment conditions.

Group I (Chemical pulping)			**Group II (Enzymatic pulping)**		
SET 1	SET 2	SET 3	SET 1	SET 2	SET 3

- **Collection and evaluation of effluent:**

Effluent produced from both the experimental groups during the making of pulp will be collected and various physico-chemical parameters will be analyzed and compared (Table 3).

S.No	**PARAMETERS**	**METHOD & NUMBER***
1.	(Biochemical Demand)BOD	3-days BOD test (5210 B)
2.	(Chemical Oxygen Demand)COD	Closed reflux titrimetric method (5220 C)
3.	Colour	Spectophotometric method (2120 C)
4.	Turbidity	Nephelometric method (2130 B)
5.	(Total Suspended Solids)TSS	(2540 D)
6.	(Total Dissolve Solids)TDS	(2540 C)
7.	Ph	pH meter
8.	Conductivity	Conductivity meter (2510 B)
9.	Lignin	TAPPI method
10.	(Residual Active Alkali)RAA	TAPPI method

Table 3: Methods use for evaluation of effluent parameters

*** Test methods are as per APHA standard methods (20th edition, 1999)**

- **Preparation of sample handsheet:**

  Handsheets will be prepared using the extracted pulp (Both enzymatically and chemically).

- **Evaluation of physical strength properties:**

  Physical strength properties like tear strength, tensile strength, burst strength and double fold will be evaluated in both the experimental groups using standard TAPPI test methods (Table 4).

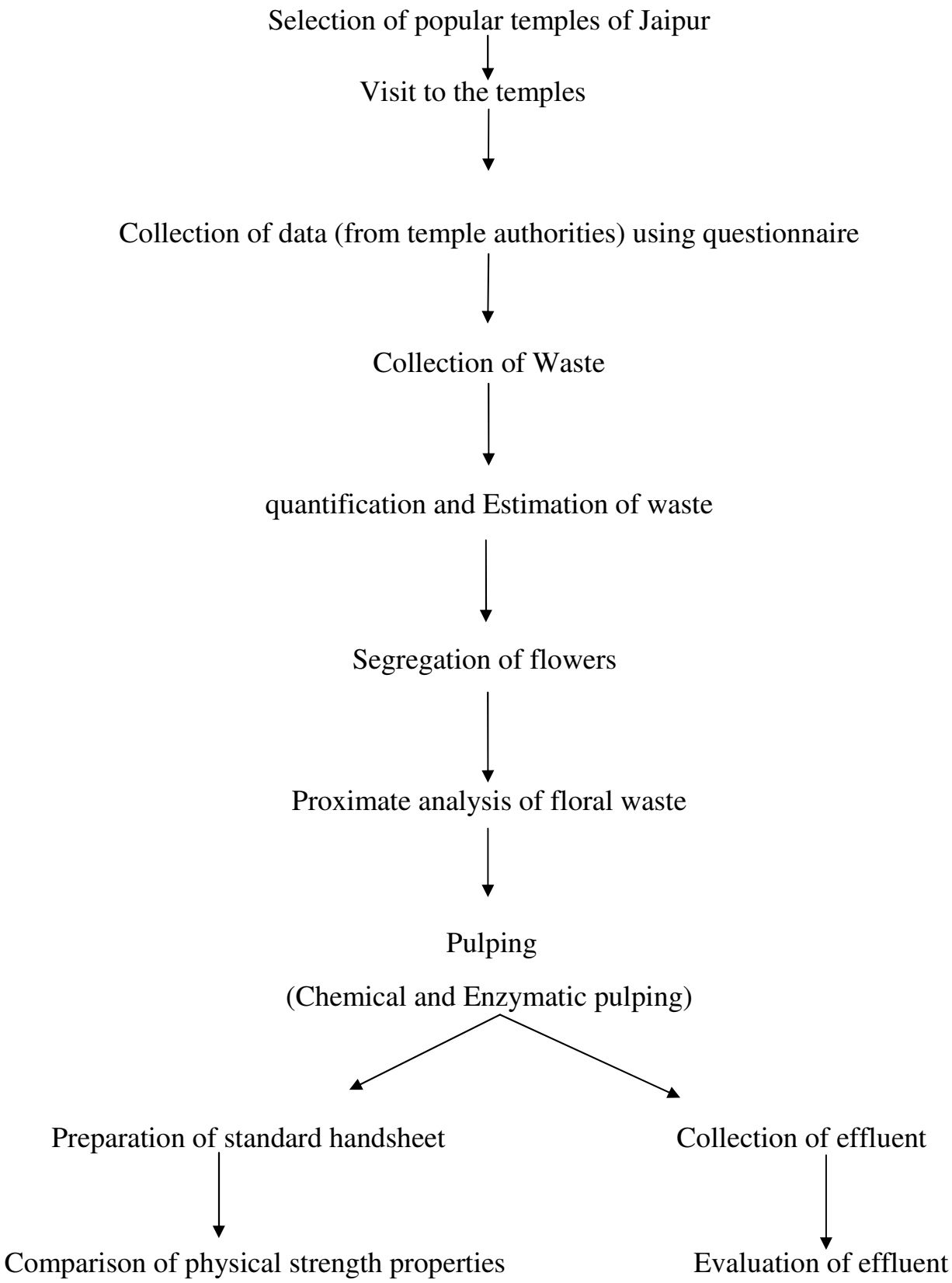
S. No.	NAME OF THE PARAMETER	TEST PROCEDURE
1.	Tensile Index	ISO 1924
2.	Tear Index	ISO 1974
3.	Folding Endurance	T 423
4.	Burst Strength	T 403
5.	Brightness	ISO 2471

Table 4: Standard Test Procedures of Physical Strength Properties

- **Statistical analysis:**

  The data and the results obtained will be analyzed statistically with appropriate tests.

WORK PLAN


Selection of popular temples of Jaipur
Visit to the temples
Collection of data (from temple authorities) using questionnaire
Collection of Waste
quantification and Estimation of waste
Segregation of flowers
Proximate analysis of floral waste
Pulping
(Chemical and Enzymatic pulping)
Preparation of standard handsheet
Collection of effluent
Comparison of physical strength properties
Evaluation of effluent

Significance of the study

- This study will propose an alternative approach to waste management since the waste will neither be land filled nor burnt but would be used as a resource that will be recycled.
- Sustainable technology like handmade paper making can be successfully applied in temples and help for safe disposal of the floral wastes and hence promote zero waste management.
- Handmade paper formed could be used for making of hand bags, envelops, cards *etc*.
- The study will throw light on reducing volume of temple waste which would eventually generate additional revenues for temples.
- Floral waste utilization would eventually be beneficial to the society as people would get to live in a cleaner and a healthier environment.
- The “green temple concept” can prove to be helpful in government policy formulation.

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